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CONTRACTOR: WESTERN RESEARCH CORPORATION
8616 Commerce Avenue
San Diego, CA 92121

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PROJECT ENGINEER: (10) Nino R./Pereira
714/578-5885

EFFECTIVE DATE OF CONTRACT: 15 August 80

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CONTRACT EXPIRATION DATE: (11) 15 Feb[redacted] 81

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S/C 395516

R&D STATUS REPORT - 8/15 to 11/15

The feasibility studies on the transverse RF accelerator are progressing in all areas covered by the contract. The initial estimates have generally been corroborated by our calculations; these will now be described briefly.

The electromagnetic fields in the RF acceleratory cavity, a prolate ellipsoid of revolution, were analysed in terms of known special functions. A computer program for these functions was acquired and implemented. We are presently using the program to verify the asymptotic fields used in energy transfer calculations.

An analytical calculation of beam loading gave mixed results. The difficulty is that the beam is resonant with the fields, and therefore strongly perturbed; hence the loading problem is fully nonlinear and very difficult to solve analytically. The loading will be considered as part of the numerical study sub-contracted to B. Godfrey of Mission Research Corporation. This numerical work has started late, and will be completed probably one month behind schedule, but before February 15.

The calculations on front end injection of electron bunches show that large currents in the kilo ampere range can be injected. A laser-activated cathode would emit electron bunches which can be laterally compressed without excessive de-bunching.

Only minor emittance calculations have been performed to date. Since the electromagnetic fields are now known exactly there should be no trouble with this.

A result of some general interest has emerged from the wall loading calculations. When a plane electromagnetic wave impinges on a mirror, the surface currents flow in the same direction throughout the

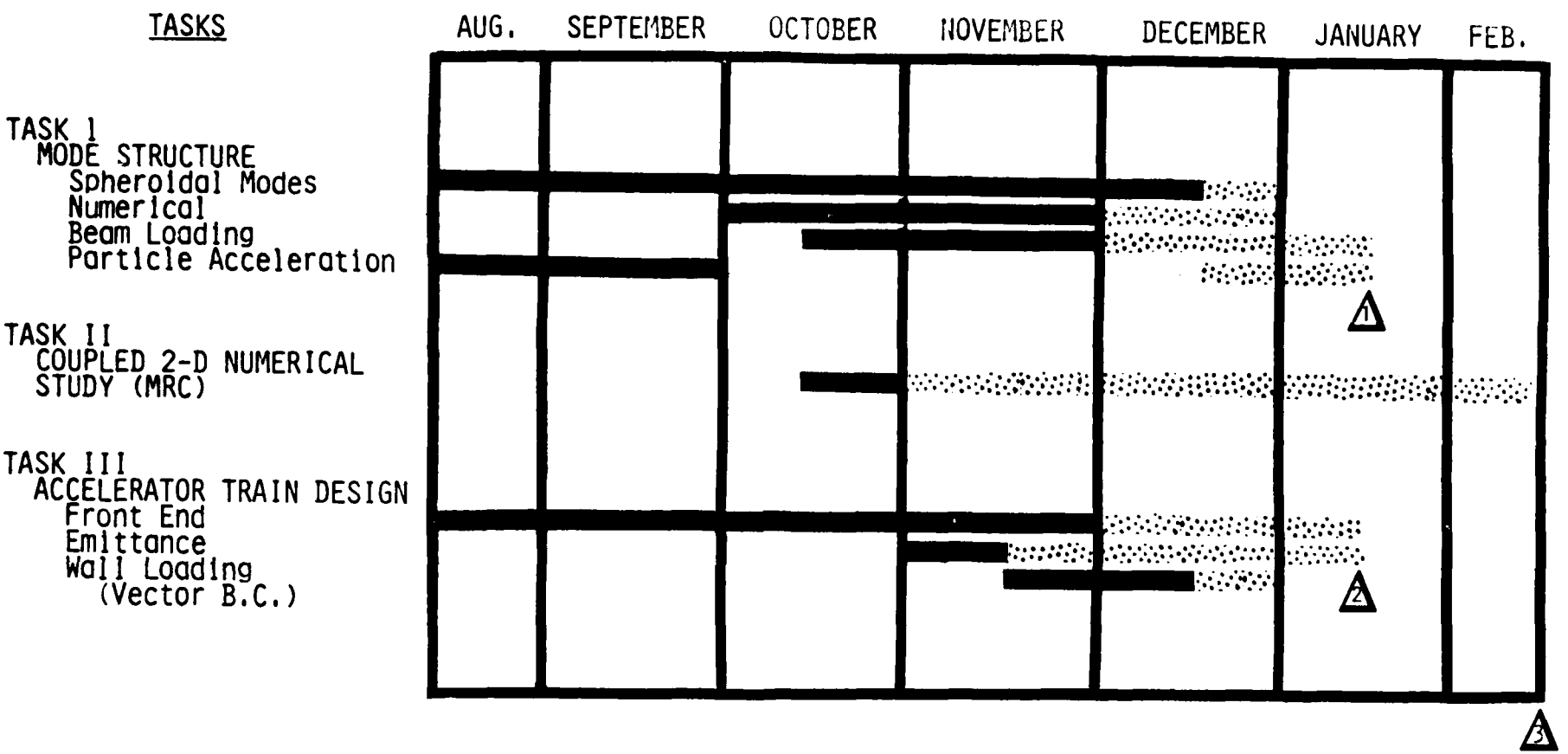
surface at any given time. However, when the wave is spatially modulated the surface currents are in opposite directions in neighboring regions. Therefore, a charge accumulation builds up in between these regions, and an electric field normal to the surface is inevitable.

The high electric fields that make the transverse RF accelerator so attractive were estimated from the Joule heating limit, but the above analysis shows that there may be some breakdown limitation also. However, our estimates show that breakdown can be prevented by working with a wavelength short compared to the spatial acceleration pattern on the mirror.

Two topics have been prepared for possible publication; one is the principle of the transverse RF accelerator, submitted to Appl. Phys. Lett., the other is the de-bunching calculation for front-end injection, submitted to Phys. Fluids. This last paper was presented at the 1980 APS plasma physics meeting (paper 4Z27).

Our assessment of the progress in transverse RF accelerator studies is given in Figure 1. The completed components of the work are shaded, while the blank areas indicate the part that remains to be done.

SCHEDULE


TASKS
AUG.
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEB.
TASK I
MODE STRUCTURE
Spheroidal Modes
Numerical
Beam Loading
Particle Acceleration
TASK II
COUPLED 2-D NUMERICAL STUDY (MRC)
TASK III
ACCELERATOR TRAIN DESIGN
Front End
Emittance
Wall Loading
(Vector B.C.)
1
2
3
1 Cavity Behavior
2 Current Limitations
3 Accelerator Assessment
Work Completed
Scheduled Work

FISCAL STATUS

Contract No. N00014-80-C-0902
15 August 1980 thru 15 February 1981

1.	Amount currently provided on contract:	$64,419
2.	Expenditures and commitments to date:	37,430
3.	Funds required to complete work:	26,989